

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

1. Claims 1-29 and 49-51 are rejected under 35 U.S.C. 103(a) as being anticipated by Harel et al. (WO 02/067014, which is a publication of PCT/IL02/00124; for examination purposes, the US Publication 2005/0118527 will be referred to in the rejection).

Regarding claims 1, 3 and 4, Harel discloses a photodetector (Fig. 14) comprising:

a first semiconductor layer (4, Fig. 14) comprising a first semiconductor material (¶ [0186]: lead iodide); and

a second semiconductor layer (5, Fig. 14) comprising a second semiconductor material (¶ [0186]: mercuric iodide) coupled to the first semiconductor material, the first and second semiconductor layers forming a heterojunction (¶ [0187]: "hybrid bi-layer"), the first and second semiconductor materials being halides (¶ [0188]:  $\text{PbI}_2$  and  $\text{HgI}_2$ ).

Although Harel does not disclose in this embodiment that the first and second semiconductor layer are consisting of a first and second semiconductor material, respectively, however, Harel shows in Fig. 13 that PVD deposited lead iodide and PVD deposited mercuric iodide have greater sensitivity than PIB lead iodide composite and PIB mercuric iodide composite, respectively. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention, to form the first and second semiconductor layer consisting of semiconductor materials, such as PVD deposited lead iodide and PVD deposited mercuric iodide, respectively, in order to provide a photo-detector with greater sensitivity. Furthermore, Harel discloses that lead iodide and mercuric iodide were well known, and conventionally used in photo-detectors (§ [0002]-[0019]), at the time of invention.

Regarding claim 2, since Harel teaches the same materials as claimed by Applicant, it is implicit that Harel's semiconductor materials also have approximately the same bandgap. It has been held that claimed properties are presumed to be inherent when the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes (**MPEP 2112.01**).

Regarding claims 5 and 6, Harel discloses the photodetector further comprising: a first contact (bottom pixel electrode, § [0187]); and a second contact (6, Fig. 14), wherein the plurality of semiconductor materials are disposed between the first and second contacts (Fig. 14), wherein at least one of the first and second contacts comprises palladium (§ [0141]).

Regarding claim 7, Harel discloses wherein the second semiconductor material comprises mercuric iodide ( $\text{HgI}_2$ , Fig. 13) and the first semiconductor material ( $\text{PbI}_2$ , Fig. 13) is less chemically reactive than mercuric iodide with the contacts. It has been held that claimed properties are presumed to be inherent when the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes (**MPEP 2112.01**).

Regarding claims 8-12, Harel does not disclose the thicknesses of the first and second semiconductor material. However, it has been held that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover optimum or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 105 USPQ 233, 234 (CCPA 1955). Furthermore, where patentability is said to be based upon particular chosen range or dimension recited in a claim, the Applicant must show that the chosen range or dimension is critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to form the first, and second semiconductor materials with a thickness in the claimed ranges, for the purpose of optimization through routine experimentation. Furthermore, note that the claimed ranges are not critical nor do they yield unpredictable results.

Regarding claims 13-15, Harel discloses a photodetector (Fig. 14) comprising: a plurality of semiconductor materials (§ [0186]-[0190]) comprising:

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a first semiconductor layer (4, Fig. 14) comprising a first semiconductor material (¶ [0186]: lead iodide); and

a second semiconductor layer (5, Fig. 14) comprising a second semiconductor material (¶ [0186]: mercuric iodide) coupled to the first semiconductor material, the first and second semiconductor layers forming a first heterojunction (¶ [0187]: "hybrid bi-layer"), the first and second semiconductor materials being halides (¶ [0188]:  $\text{Hgl}_2$  and  $\text{Pbl}_2$ );

wherein the first and second semiconductor material comprises lead iodide and mercuric iodide, respectively (¶ [0188]:  $\text{Pbl}_2$  and  $\text{Hgl}_2$ );

wherein the plurality of semiconductor materials further comprises a third semiconductor layer comprising a third semiconductor material comprising lead iodide (¶ [0190]: "lead iodide PIB layer") coupled to the second semiconductor material (¶ [0190]: "mercuric iodide PIB layer"), the second and third semiconductor layers forming a second heterojunction (¶ [0190]: "tri-layer").

Although Harel does not disclose in this embodiment that the first, second and third semiconductor layer are consisting of a first, second and third semiconductor material, respectively, however, Harel shows in Fig. 13 that PVD deposited mercuric iodide and PVD deposited lead iodide have greater sensitivity than PIB mercuric iodide composite and PIB lead iodide composite, respectively. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention, to form the first, second and third semiconductor layer consisting of semiconductor materials, such as PVD deposited lead iodide and PVD deposited mercuric iodide, respectively, in order to

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provide a photo-detector with greater sensitivity. Furthermore, Harel discloses that semiconductor materials such as lead iodide and mercuric iodide were well known, and conventionally used in photo-detectors (§ [0002]-[0019]), at the time of invention.

Regarding the claimed band gap of the first, second and third semiconductor material, note that the band gap is a property of the material and Harel teaches the same materials as claimed by Applicant. It has been held that claimed properties are presumed to be inherent when the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes (**MPEP 2112.01**).

Regarding the claimed thicknesses of the first, second and third semiconductor material, it has been held that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover optimum or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 105 USPQ 233, 234 (CCPA 1955).

Furthermore, where patentability is said to be based upon particular chosen range or dimension recited in a claim, the Applicant must show that the chosen range or dimension is critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to form the first, second and third semiconductor materials with thicknesses as claimed, for the purpose of optimization through routine experimentation. Furthermore, note that the claimed ranges are not critical nor do they yield unpredictable results.

Regarding claims 16-18, Harel discloses wherein the first semiconductor material comprises lead iodide and the second semiconductor material comprises mercuric iodide and each of the first and second semiconductor materials consists of a semiconductor material (Fig. 13: PVD-PbI<sub>2</sub> and PVD-HgI<sub>2</sub>). Furthermore, regarding the limitations of having different "conductivity types," and band gaps within "10 percent of each other," note that Harel discloses similar materials, and thus, the claimed properties are implicit. It has been held that claimed properties are presumed to be inherent when the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes (**MPEP 2112.01**).

Regarding claim 19, Harel discloses a photodetector (Fig. 14) comprising:  
a first semiconductor layer (5, Fig. 14) comprising a first semiconductor material (¶ [0186]: mercuric iodide); and  
a second semiconductor layer (4, Fig. 14) comprising a second semiconductor material (¶ [0186]: lead iodide) coupled to the first semiconductor material, the first and second semiconductor layers forming a heterojunction (¶ [0187]: "hybrid bi-layer"), the first and second semiconductor materials being halides (¶ [0188]: PbI<sub>2</sub> and HgI<sub>2</sub>);  
wherein the first semiconductor material comprises mercuric iodide and the second material comprises lead iodide (¶ [0188]).

Although Harel does not disclose in this embodiment that the first and second semiconductor layer are consisting of a first and second semiconductor material,

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respectively, however, Harel shows in Fig. 13 that PVD deposited lead iodide and PVD deposited mercuric iodide have greater sensitivity than PIB lead iodide composite and PIB mercuric iodide composite, respectively. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention, to form the first and second semiconductor layer consisting of semiconductor materials, such as PVD deposited mercuric iodide and PVD deposited lead iodide, respectively, in order to provide a photo-detector with greater sensitivity. Furthermore, Harel discloses that lead iodide and mercuric iodide were well known, and conventionally used in photo-detectors (§ [0002]-[0019]), at the time of invention.

Regarding the claimed conductivity type and band gap of the semiconductor materials, note that the limitations are drawn to the properties of the materials, and Harel teaches the claimed materials. It has been held that claimed properties are presumed to be inherent when the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes (**MPEP 2112.01**).

Regarding the relative thickness of the second semiconductor layer to the first semiconductor layer, note that where patentability is said to be based upon particular chosen range or dimension recited in a claim, the Applicant must show that the chosen range or dimension is critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to form the second semiconductor material thicker

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than the first semiconductor material, because changes in dimension are generally recognized as being within the level of ordinary skill in the art.

Regarding claim 20, Harel discloses wherein the plurality of semiconductor materials further comprises a third semiconductor material comprising lead iodide coupled to the second semiconductor material (¶ [0190]).

Regarding claims 21-23, Harel discloses wherein the first semiconductor material comprises bismuth iodide and the second semiconductor material comprises one of mercuric iodide and lead iodide (¶ [0186]).

Regarding claims 24-26, Harel discloses wherein the first semiconductor material comprises thallium bromide and the second semiconductor material comprising one of mercuric iodide and lead iodide (¶ [0186]).

Regarding claims 27-29, note that the limitations of “negative bias,” “ground” and “negative voltage,” are drawn to intended use. It has been held that a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus satisfying the claimed structural limitations. *Ex parte Masham*, 2 USPQ F.2d 1647 (1987).

Regarding claims 49 and 50, Harel discloses a photodetector (Fig. 14) comprising:

a first semiconductor layer (4, Fig. 14) comprising a first semiconductor material (¶ [0186]: lead iodide); and

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a second semiconductor layer (5, Fig. 14) comprising a second semiconductor material (¶ [0186]: mercuric iodide) coupled to the first semiconductor material, the first and second semiconductor layers forming a heterojunction (¶ [0187]: “hybrid bi-layer”), the first and second semiconductor materials being halides (¶ [0188]:  $\text{PbI}_2$  and  $\text{HgI}_2$ );

wherein the first semiconductor material comprises lead iodide and the second material comprises mercuric iodide (¶ [0188]).

Although Harel does not disclose in this embodiment that the first and second semiconductor layer are consisting of a first and second semiconductor material, respectively, however, Harel shows in Fig. 13 that PVD deposited lead iodide and PVD deposited mercuric iodide have greater sensitivity than PIB lead iodide composite and PIB mercuric iodide composite, respectively. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention, to form the first and second semiconductor layer consisting of semiconductor materials, such as PVD deposited lead iodide and PVD deposited mercuric iodide, respectively, in order to provide a photo-detector with greater sensitivity. Furthermore, Harel discloses that lead iodide and mercuric iodide were well known, and conventionally used in photo-detectors (¶ [0002]-[0019]), at the time of invention.

Regarding the claimed conductivity type of the semiconductor materials, note that the limitations are drawn to the properties of the materials, and Harel teaches the claimed materials. It has been held that claimed properties are presumed to be inherent when the claimed and prior art products are identical or substantially identical in

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structure or composition, or are produced by identical or substantially identical processes (**MPEP 2112.01**).

Regarding claim 51, Harel discloses wherein the first semiconductor layer is a single first semiconductor material ( $\text{PbI}_2$ ) and the second semiconductor layer is a single second semiconductor material ( $\text{HgI}_2$ ) (Fig. 13).

### ***Response to Arguments***

2. Applicant's arguments with respect to claims 1-29 and 49-51 have been fully considered but are not persuasive.

Regarding the Harel reference, Applicant argues:

"Thus, to teach claim 1, the Patent Office relies upon substituting the PIB layers in Harel with a PVD material (see OA pg. 3 para. 4). However, the particles and binder layers of Harel cannot be substituted with a semiconductor layer consisting of a semiconductor material, as required by the claims because Harel teaches against such practice. As noted in the Remarks above and discussed during the Examiner Interview, Harel teaches against PVD deposited semiconductor, by criticizing, discrediting, or otherwise discouraging PVD semiconductor due to difficulty of fabrication, increased cost, and safety problems (see Harel, paras. 134 and 161 of corresponding US. Pub. 2005/0118527) (Depuy Spine, Inc. v Medtronic Sofamor Danek, Inc. (CFAC Docket 2008-1240, -1253, -1401, decided June 1, 2009, page 14-15 (also see MPEP 2141.02 and 2143.01)). Harel also teaches a primary purpose and principle of operation of using PIB layers to cure the problems of the PVD layer imagers noted above (see Harel, paras. 24, 21, 134, 161, and 187-188; and Figures 6 and 12-13 of corresponding US. Pub. 2005/0118527) (see MPEP § 2143.01 V and VI). Thus, Harel teaches against and cannot be properly combined with any technology or reference to teach the semiconductor layers consisting of semiconductor materials forming a heterojunction and being halides, as required by the limitations of claim 1."

The argument is not persuasive. In paragraphs [0134] and [0161] of US 2005/0118527, Harel does not "criticize, discredit and otherwise discourage" PVD fabricated imagers, but rather, Harel describes the advantages of composite imagers over the PVD imagers. Note that in these paragraphs cited by the Applicant, Harel

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states that “the ease of fabrication, their low cost, and the increase in safety of these composite imagers make them more desirable than PVD fabricated imagers (emphasis added).” Thus, it is clear that Harel expresses a general preference for composite imagers (“more desirable”), but does not criticize, discredit and otherwise discourage investigation into the claimed invention, and thus, does not teach against PVD deposited semiconductor material. See *Depuy Spine, Inc. v Medtronic Sofamor Danek, Inc.* (CFAC Docket 2008-1240, -1253, -1401, decided June 1, 2009, page 14-15). In fact, in Fig. 13, Harel discloses an advantage PVD imagers have over the composite imagers, in that PVD-HgI<sub>2</sub> and PVD-PbI<sub>2</sub> have greater sensitivity than their composite counterparts. Thus, for both PVD imagers and composite imagers, Harel discloses that there is a tradeoff between the cost of fabrication and sensitivity, which illustrates that this is an issue of general preference rather than teaching away.

Furthermore, it has been held that disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments. *In re Susi*, 440 F.2d 442, 169 USPQ 423 (CCPA 1971). Also, “[A] known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use.” *In re Gurley*, 27 F.3d 551, 554, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994). In the instant case, PVD deposited semiconductors used in imagers were well known and obvious at the time of the invention, as disclosed by Harel (paragraphs [0006]-[0020] of US 2005/0118527), and are well known for their high sensitivity, but are inferior to composite imagers in terms of fabrication and cost.

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Regarding Applicant's argument that Harel teaches a primary purpose and principle of operation of using PIB layers to cure the problems of the PVD layer imagers, the argument is not persuasive, since Harel discloses that PVD layers have greater sensitivity than the PIB layers (Fig. 13 of Harel), and PVD deposited semiconductor imagers were well known and obvious at the time of the invention (para. [0006]-[0020] of Harel). Furthermore, note that Harel is not curing any operational problems of the PVD layer imagers, but rather the cost of manufacturing such devices.

Applicant also argues that "the mention of PVD imagers in Harel in no way teaches or suggest the specific layers and materials claimed by the applicant. Thus, applicant submits that even if Harel did not teach away, there has been no prima facie case of obviousness shown from the proposed combination."

The argument is not persuasive. As set forth in the rejection of claim 1 above, a prima facie case of obviousness was made which disclosed and made obvious the specific layers and materials claimed by the applicant:

"Harel discloses a photodetector (Fig. 14) comprising: a first semiconductor layer (4, Fig. 14) comprising a first semiconductor material (¶ [0186]: lead iodide); and a second semiconductor layer (5, Fig. 14) comprising a second semiconductor material (¶ [0186]: mercuric iodide) coupled to the first semiconductor material, the first and second semiconductor layers forming a heterojunction (¶ [0187]: "hybrid bi-layer"), the first and second semiconductor materials being halides (¶ [0188]:  $\text{PbI}_2$  and  $\text{HgI}_2$ ).

Although Harel does not disclose in this embodiment that the first and second semiconductor layer are consisting of a first and second semiconductor material, respectively, however, Harel shows in Fig. 13 that PVD deposited lead iodide and PVD deposited mercuric iodide have greater sensitivity than PIB lead iodide composite and PIB mercuric iodide composite, respectively. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention, to form the first and second semiconductor layer consisting of semiconductor materials, such as PVD deposited lead iodide and PVD deposited mercuric iodide, respectively, in order to provide a photo-

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detector with greater sensitivity. Furthermore, Harel discloses that lead iodide and mercuric iodide were well known, and conventionally used in photo-detectors (§ [0002]-[0019]), at the time of invention (emphasis added)."

Applicant's arguments regarding claim 13 is also not persuasive, in view of the rejection of claim 13, as set forth above, which states:

"Although Harel does not disclose in this embodiment that the first, second and third semiconductor layer are consisting of a first, second and third semiconductor material, respectively, however, Harel shows in Fig. 13 that PVD deposited mercuric iodide and PVD deposited lead iodide have greater sensitivity than PIB mercuric iodide composite and PIB lead iodide composite, respectively. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention, to form the first, second and third semiconductor layer consisting of semiconductor materials, such as PVD deposited lead iodide and PVD deposited mercuric iodide, respectively, in order to provide a photo-detector with greater sensitivity. Furthermore, Harel discloses that semiconductor materials such as lead iodide and mercuric iodide were well known, and conventionally used in photo-detectors (§ [0002]-[0019]), at the time of invention.

Regarding the claimed band gap of the first, second and third semiconductor material, note that the band gap is a property of the material and Harel teaches the same materials as claimed by Applicant. It has been held that claimed properties are presumed to be inherent when the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes (**MPEP 2112.01**)."

Applicant's arguments regarding claim 19 is also not persuasive, in view of the rejection of claim 19, as set forth above, which states:

"Although Harel does not disclose in this embodiment that the first and second semiconductor layer are consisting of a first and second semiconductor material, respectively, however, Harel shows in Fig. 13 that PVD deposited lead iodide and PVD deposited mercuric iodide have greater sensitivity than PIB lead iodide composite and PIB mercuric iodide composite, respectively. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention, to form the first and second semiconductor layer consisting of semiconductor materials, such as PVD deposited mercuric iodide and PVD deposited lead iodide, respectively, in order to provide a photo-detector with greater sensitivity. Furthermore, Harel discloses that lead iodide and mercuric iodide were well known, and conventionally used in photo-detectors (§ [0002]-[0019]), at the time of invention.

Regarding the claimed conductivity type and band gap of the semiconductor materials, note that the limitations are drawn to the properties of the materials, and Harel teaches

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the claimed materials. It has been held that claimed properties are presumed to be inherent when the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes (**MPEP 2112.01**)."

Applicant's arguments regarding the Expert Opinion in the Response mailed on November 6, 2006, is not persuasive. Note, the Expert Opinion is not relevant anymore since the grounds of rejection, to which the Response was filed, has changed. Furthermore, as addressed above, Harel does not teach against using PVD deposited semiconductor layers, because Harel expresses a general preference for composite imagers (paras. [0134] and [0161] of Harel), and does not "criticize, discredit, or otherwise discourage" investigation into the invention claimed.

### ***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Abul Kalam whose telephone number is (571)272-8346. The examiner can normally be reached on Monday - Friday, 9 AM - 5 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/A. K./  
Examiner, Art Unit 2814

/Wael M Fahmy/  
Supervisory Patent Examiner, Art  
Unit 2814